

A new species of *Puffinus* shearwater from the western Indian Ocean

by Hadoram Shirihai, Ian Sinclair & Peter R. Colston

Received 3 February 1995

A small *Puffinus* shearwater that was found alive on a beach at Durban on the east coast of South Africa on 20 January 1987, but died shortly after, was considered to be indeterminate in certain characters (Berruti 1990). This specimen was presented to the Durban Museum where it was also examined in detail by IS. In September 1994 it was sent on loan to The Natural History Museum, formerly the British Museum (Natural History) (BM(NH)), Tring, where PRC and HS were able to compare it with a wide range of specimens of both Audubon's Shearwater *P. lherminieri* and Little Shearwater *P. assimilis*. While doing so, we located a further specimen in the BM (NH) skin collection (see below) which visual and x-ray study showed closely to match the Durban specimen in plumage and structure as well as differing from all other specimens.

Besides the two specimens mentioned above, IS took photographs of an apparent adult of this form captured on Durban beach in August 1981 (but prematurely released without measurements), and HS had good views and took photographs of another individual at Eilat, Israel, between 18 and 21 June 1992. There is also an earlier observation by IS of a similar bird watched close inshore for an extended period at Richard's Bay, South Africa (28°47'S, 32°05'E) on 20 February 1976 (Shirihai & Sinclair 1994). We are convinced that we are not dealing with aberrant individuals since what is apparently this form has been found to be locally abundant in the western Indian Ocean (Shirihai & Sinclair 1994). Between January 1990 and January 1993, IS observed many such individuals seemingly identical to the above mentioned specimens. These birds occurred both south and north of the Comoro Islands, west and south of Aldabra (Seychelles), in the Mozambique Channel (including around the Bassas da India atoll), and east of Maputo, Mozambique (see Table 1). In these areas, they were easily recognised at sea by their larger size (compared with Little Shearwater), and very black-and-white appearance with white undertail coverts, reminiscent of Manx Shearwater *P. puffinus*, but smaller and with much quicker wing-beats.

We appreciate that the taxonomy of the small and medium-sized shearwaters is still full of uncertainties; but this distinctive form cannot, on present evidence, be assigned to and treated as a subspecies of any known form. We therefore consider that it should be treated as a new species, for which we propose the name

***Puffinus atrodorsalis* sp. nov.**

Holotype. Adult, unsexed, found alive on the beach, Durban, South Africa (29°53'S, 31°00'E), 20 January 1987 (died shortly after).



Figure 1. *Puffinus atrodorsalis* sp. nov. Durban, South Africa, August 1981. (Photograph: Ian Sinclair.)

Freeze-dried specimen lodged in the Durban Natural Science Museum, DNSM No. 36093.

Diagnosis. Medium-sized shearwater with characteristic black-and-white plumage and distinctive, hooded appearance of head. Relatively long wings and tail, as well as bill, approaching *P. puffinus* in proportions, but in length distinctly smaller (i.e. overall size *c.* 15% smaller), and in this respect closer to the *assimilis/lherminieri* complex (*c.* 5% larger). Similar bare part colouration to *assimilis* (see below), but differs in its larger size, longer wing, tail, and bill (see Appendix), and lack of predominantly white remiges below and variable whitish or pale extensions around the eye. Differs from *lherminieri* in lacking a predominantly brown hue to the upperparts and undertail coverts; also lacks that species' well-developed nasal tubes and maxillary unguis, and has bluish-grey, not fleshy-pink, legs. In view of the considerable size difference, we consider that there is no further need to discuss *P. puffinus* and its closely related forms (*auricularis*, *gavia*, *huttoni*, *nativitatis*, *opisthomelas*, *yelkouan*).

Description of type. Uniformly saturated blackish dorsally; black crown extends to just below the eye and is sharply demarcated. A small, indistinct diffuse area (greyish-white mottling) mainly on lower ear-coverts and indistinctly behind, also some whitish feathering on upper eye crescent and a conspicuous black loreal patch. Within the otherwise uniformly black upperparts (head to rectrices, also entire upper wing), there are only some narrow, indistinct, diffuse (fresh) whitish tips to the greater coverts. Otherwise, the obvious demarcation



Plate 1. Top, *Puffinus atrodorsalis* holotype; DNSM no. 36093, adult, Durban, South Africa, 20 January 1987. Middle, *P. atrodorsalis*; BMNH no. 1866.7.21.10, juvenile, Réunion. Bottom, *P. lherminieri bailloni*; BMNH no. 1969.5.1, adult, Réunion. Note heavier bill and darker, more extensive pectoral patches than in *atrodorsalis*.

TABLE 1
Sight records corresponding to *Puffinus atrodorsalis* in the western Indian Ocean, made by I.S.

Position	Co-ordinates	Date	No. of birds
1990			
80 km NW of Nosy Bé, Madagascar	12.50'S, 47.40'E	2 Jan	10
90 km NE of Mayotte, Comoro Is.	12.00'S, 45.50'E	4 Jan	14
5 km S. of Aldabra Is. (Seychelles)	9.22'S, 46.28'E	5 Jan	4
180 km NE of Aldabra Is. (Seychelles)	8.10'S, 47.30'E	7 Jan	3
1991			
80 km NE of Vohimarina, Madagascar	13.22'S, 50.00'E	12 May	8-10
40 km NE of Antseranana [Diego-Suarez], Madagascar	12.19'S, 49.17'E	14 May	4
150 km NE of Nosey Bé, Madagascar	12.30'S, 47.10'E	18 May	12
50 km S of Grand Comoro	12.25'S, 43.30'E	20 May	40-50
60 km W of Grand Comoro	11.45'S, 42.52'E	22 May	6
90 km E of Mombasa, Kenya	4.04'S, 40.30'E	29 May	2
500 km E of Mombasa, Kenya	4.04'S, 44.15'E	2 Jun	6-10
120 km NE of Aldabra Is. (Seychelles)	8.50'S, 47.10'E	9 Jun	30-40
50 km SW of Aldabra Is. (Seychelles)	9.22'S, 46.28'E	11 Jun	15-20
100 km NE of Mayotte. Comoro Is.	12.00'S, 46.00'E	10 Jun	20-30
20 km S of Grand Comoro	12.10'S, 43.45'E	14 Jun	3
190 km NE of Tolanaro [Fort Dauphin], Madagascar	24.00'S, 48.12'E	28 Aug	5
330 km NE of Madagascar	9.45'S, 51.15'E	29 Aug	9
180 km NE of Durban, South Africa	29.10'S, 32.30'E	5 Dec	2
Bassas da India Atoll, Mozambique Channel	21.15'S, 39.45'E	7 Dec	4
100 km SW of Nosy Bé, Madagascar	13.40'S, 47.20'E	8 Dec	3
200 km SW of Mauritius	21.45'S, 55.50'E	22 Dec	4
150 km SE of Réunion Is.	22.15'S, 56.50'E	27 Dec	10
1992			
80 km NE of Maputo, Mozambique	25.40'S, 33.25'E	18 Dec	2
100 km E of Maputo, Mozambique	25.58'S, 33.10'E	20 Dec	4
1993			
100 km ENE of Maputo, Mozambique	25.40'S, 33.40'E	20 Jan	3

between the black upperparts and white underparts is only broken by a small amount of blackish-brown mottling to the sides of the neck/breast. The foreneck, throat, breast and flanks are unmarked white, separated from the white undertail coverts by a partial blackish-brown divide, formed by a lateral extension or notch of dark feathering which extends narrowly down from the rump and on to the thigh. Also, the white undertail coverts show some inconspicuous, diffuse greyish mottling (c. 2-3.5 mm wide) on the outer webs of the longest outer coverts (in the field undertail coverts appear wholly white). The underwing coverts are unmarked pure white, narrowly framed with blackish-brown on the leading edge of the wing; the remiges are mostly dusky-grey to blackish, with indistinctly lighter or

whiter shades to the basal outer webs of the outer primaries; axillaries white.

Bare parts. Bill proportionally relatively long (i.e. relatively longer than *assimilis*) and typically slender with poorly developed nasal tubes and maxillary unguis, bluish-grey with blackish shade on culmen ridge. Legs (colours recorded when alive): inner tarsus, two inner toes and webs bluish-grey (top half of outer tarsus on specimen appears similarly pale), remainder of legs and feet black.

Measurements of holotype (mm). Wing 204.5 (maximum chord); tail 78; bill 28 (culmen from feathers), 34 (from skull), 20.5 (from anterior nostril to bill tip); tarsus 40.

Measurements of other individuals (mm). Juvenile at point of fledging, male, undated, L'île de la Réunion, BM (NH) reg. no. 1866. 7. 21. 10, purchased from Maison Verreaux. Wing 162 (visible primaries 7–10 growing), tail 74 (very abraded), bill 28.5 (culmen from feathers), 35 (from skull), tarsus 39. Resembles holotype (including similar shape/pattern of dark and light areas of bill/legs), but upperparts differ in duller blackish-brown appearance. The advanced stage of juvenile plumage suggests collection on or near the breeding area.

English name. We suggest Mascarene Shearwater, after the oceanic Mascarene ridge which may form part of the breeding range.

Additional characters (from similar, live birds). Although Audubon's and Little Shearwaters are superficially rather similar to our new species in plumage, there are also important differences in structure, proportions and movement. On the water and in flight, *atrodorsalis* appears intermediate between Manx (but obviously distinctly smaller) and Little (races *assimilis*, *baroli*, *tunneyi*, but obviously larger than these). In size, it may approach the Southern Oceans race *elegans* of the Little Shearwater, but its general appearance is slimmer (i.e. proportionally more slender-billed, longer-winged and longer-tailed), and it has the more black and white appearance of the Manx Shearwater. The flight action is also intermediate: in calm weather it flies with rapid, almost whirring shallow wing-beats (although not as fast as Little), interspersed with frequent glides and shears, fairly close to the surface (even in a wind-force of 2–4); in stronger winds it arches higher, but its travelling flight is rarely as powerful or sustained as Manx.

Individual variation. The few specimens that we have been able to examine in the hand or observe closely in the field show that there is a small amount of individual variation; e.g. the pectoral patches (the dark feathers running down the neck sides) are moderately developed and rather distinct in the Eilat bird and the Réunion specimen, but are smaller in the bird captured in Durban in 1981 and poorly developed in the Durban specimens of 1987. The demarcation of the hood below the eye also varies; it is clear cut in the 1987 Durban individual, moderately so in the 1981 individual and the Réunion specimen, and somewhat ill-defined in the Eilat individual. The lack of sharpness in the latter was discussed in Shirihai & Sinclair (1994) and attributed to the bird's active body moult.

Relationships and recognition (see also Appendix). *Atrodorsalis* differs markedly from the North Atlantic race *baroli* of Little Shearwater (also Australasian races: nominate *assimilis* and *tuuueyi*) in being larger with relatively longer and more slender bill, dorsally blacker and lacking prominent white extensions over the eye (most noticeable in *baroli*). It more closely resembles the large races of Little including *elegans* (widespread in Southern Oceans), *haurakiensis* (islets off east coast of North Island, New Zealand), and *kermadecensis* (Kermadec group), but differs in having a proportionally longer, more slender bill and in lacking extensive pale feather tips and/or darker subterminal markings to its predominantly black (rather than greyish-black) upperparts. These larger races of *assimilis* also show a diffuse, whitish or pale area around the eye and ear-coverts and lack the distinctive black-hooded appearance typically shown by *atrodorsalis*. All the above mentioned races of *assimilis* (as well as race *myrtae*, Rapa Is.) have diagnostically white instead of dusky-grey undersides to their remiges (at least on much of the inner webs) and usually show more pronounced white-tipped greater coverts. *Atrodorsalis* also differs from the controversial *boydi* of Cape Verde Is., which different authorities refer to *P. assimilis* (Cramp & Simmons 1977) or to *P. lherminieri* (Murphy 1927, Jouanin & Mougou 1979). Although *boydi* shares similarly coloured greyish-blue legs/feet and dusky-grey remiges, it differs from *atrodorsalis* in having mainly dull brown undertail coverts (instead of white), slightly more blackish-brown upperparts, paler or whitish mottling around the eye and upper ear-coverts, and partially white lores (nearer *assimilis*), as well as smaller size, and a shorter bill like most small/medium-sized races of Little Shearwater (see below).

Proportionally, *atrodorsalis* resembles some races of Audubon's rather than Little by its longer-billed appearance, and longer and more pointed wings/tail, but it differs from *nicolae*, the most widely distributed race of Audubon's in the Indian Ocean, in lacking the brown upperparts, brown undertail coverts and prominent pectoral patches as well as in its slightly larger size (see Appendix); *nicolae* also has a broader bill with strongly developed nasal tubes and maxillary unguis, and flesh-pink legs. With *bailloni* (Mascarene Is.), *atrodorsalis* shares white undertail covers, but otherwise differs as described above for *nicolae*. Furthermore, *atrodorsalis* is distinctly different from all races of Audubon's found in the Western Atlantic (nominate *lherminieri*, *loyemilleri*) and Pacific (*bannermani*, *dichrous*, *polyuesiae*, *gunax*, *heinrothi*, *subalaris*), in lacking their distinctly browner upperparts, variably brown undertail covers, longer and stronger bill, flesh-pink legs, and more variegated underwing coverts (more widely framed by brown, with varying amount of brownish-grey on underwing coverts and axillaries). The single known individual of the recently described *temptator*, from Moheli, Comoro Islands (Louette & Herremans 1985), which we have not examined, differs strikingly in its more obvious dusky underwing and appears similar to other Audubon's races. All other allied forms of smallish/medium-sized shearwaters, including Persian Shearwater *P. (l.) persicus* (sometimes considered

separate from Audubon's), were considered, but none resembled *atrodorsalis*.

BM (NH) specimens examined:

Puffinus assimilis: *baroli* (22), *boydi* (18), *assimilis* (13), *tunneyi* (6), *kermadecensis* (7), *hanrakieusis* (1), *elegans* (9), *myrtae* (type only).

Puffinus lherminieri: *lherminieri* (12), *loyemilleri* (1), *subalaris* (9), *dichrous* (4), *polynesiae* (9), *gunax* (1), *heurothi* (none), *baumermani* (1), *bailloni* (2), *nicolae* (17), *persicus* (5, including type), *temptator* (none).
Larger *Puffinus* spp.: *puffinus* (60), *yelkouan* (50), *gavia* (13), *huttoni* (2).

Cautionary and taxonomic note

Sorting out the taxonomy of the *Puffinus assimilis/lherminieri* complex is one of the most challenging problems in avian taxonomy. Following the guidelines of LeCroy & Vuilleumier (1992), the recognition of the new species, *P. atroductalis*, first required a thorough examination of this complex in museum skins and in the literature, e.g. Murphy (1927), Bourne (1959), Palmer (1962), Vaurie (1965), Jouanin (1970), Harrison (1983), Louette & Herremans (1985) and Marchant & Higgins (1990). Our resulting tentative assessment of the relationships between the taxa revealed an obvious requirement for a thorough revision of these smaller shearwaters, almost certainly involving some lumping and splitting both specifically and subspecifically. We consider treatments of the complex thus far to have been largely a matter of intuition by various authors, with the 18 or so forms seemingly being divided arbitrarily between the two species. Most authors use the following criteria for specific separation:

Little Shearwater *P. assimilis*—blackish or greyish-black upperparts, white undertail coverts, relatively shorter wings and shorter tail, largely white inner webs to the primaries and blue-grey legs.

Audubon's Shearwater *P. lherminieri*—brownish upperparts, usually dark undertail coverts, longer wings and longer tail, darker inner webs to the primaries, flesh-pink legs, and lack of paler/more diffuse or whiter areas around the eye (common in *P. assimilis*).

The above characters hold for the most representative forms of each species but there is more variability than might be expected. For example, the Indian Ocean race *bailloni* (usually included in Audubon's) has extensive white undertail coverts instead of brown, while *boydi* (usually placed in Little) has brown undertail coverts. The latter's relationship with the race *baroli* (Madeiran Little) is probably as remote as between the various (but variable) populations of *assimilis* and *lherminieri* (Murphy 1927), as *boydi* also has dark grey remiges similar to Audubon's, but structurally and in the rest of its plumage and bare part colouration it is essentially a Little (see below). The same applies to the upper surface colouration of some so-called Audubon's forms that have more blackish-brown upperparts (e.g. *gunax*) and some of the southern representative races of Little which have rather more bluish-grey upperparts instead of black (e.g. *elegans*).

From our studies of the specimens available at The Natural History Museum, Tring, we conclude that a taxonomy solely based on the limited morphological characters (e.g. plumage colouration, wing

formula and the usual biometrics of wing, tail etc.) used at present, is inadequate and that additional external characters should be considered, e.g. bill structure (i.e. degree of development/volume/shape of nasal tubes and maxillary unguis and perhaps other characters), body/wing/tail proportions, etc. Attention should also be given to internal anatomy, differences in marine biotope, eco-biology and phenology. However, the easiest route at present in helping to solve the problem may be through DNA studies.

According to the specimens that we have examined thus far, the complex is apparently best divided into about 8 species:

P. atrodorsalis. The breeding grounds of the species seem likely to be in the southwest Indian Ocean, possibly around the Comoro Is. where numbers have been found in the season when other petrels have been reported breeding; the occurrence of a fledged juvenile from Réunion may also be relevant. Characters as detailed above.

P. assimilis. Three groups: northeast Atlantic (*baroli*, *boydi*); southwest Pacific/New Zealand/Southern Ocean (*elegans*, *kermadecensis*, *haurakiensis*, *myrtae*); Australia, Lord Howe & Norfolk Is. (*tunneyi*, *assimilis*). General characters as detailed above. These three groups are distinct from one another morphologically and/or geographically and merit further investigation into their status and relationships; *boydi* perhaps should be treated on its own.

P. lherminieri. West-central Atlantic (*lherminieri*, *loyemilleri*) and across central Pacific Ocean (*subalaris*, *dichrous*, *polynesiae*). General characters as detailed above.

P. (L.) nicolae. West Indian Ocean (*nicolae*, *bailloni*). Characterised by darker/warm sooty-brown upperparts, large conspicuous pectoral patches, whiter underwing coverts, and markedly robust bill with well developed nasal tubes and maxillary unguis.

P. (L.) gunax. Locally in west-central Pacific (New Hebrides), monotypic. Characterised by large size, deep sooty-black upperparts (often lightly edged pale, more so on greater coverts forming distinct wing-bar), light area around ear-coverts and distinctly long, slender bill. This population is distinctive but little material is available.

P. bannermani. Locally in northwest Pacific (Bonin & Volcano Is.), monotypic. Characterised by distinctive greyish collar; otherwise reminiscent of *gunax*, and may be conspecific.

P. heinrothi. New Britain (west Pacific Ocean), monotypic. Characterised by wholly dark appearance, and has been recorded as having blue-grey eyes.

P. persicus. Northern Indian Ocean, monotypic. Characterised by predominantly light brown upperparts, variegated underwing coverts and axillaries, large size and slender bill.

Vaurie (1965) proposed *bannermani* and Harrison (1983) suggested *heinrothi* as full species, and these two taxa together with *persicus* are separated by Sibley & Monroe (1990) and Hoyo (1992). The form *temptator* (Comoro Is., Indian Ocean), known only from the type specimen, is apparently rather distinct but strongly resembles Audubon's of the Pacific and west-central Atlantic Oceans (so may indicate worldwide distribution of Audubon's), although somewhat

agreeing with *persicus* in plumage (pending further study). Palmer (1962) and Jouanin & Mougín (1979) suggest that the status of birds from Ascension Is. and probably the Gulf of Guinea (C. and E. Atlantic Ocean), also Amsterdam and St. Paul Is. (S. Indian Ocean), is uncertain and that they may contain undescribed taxa; but other recent South Atlantic records may suggest differently (see below).

Other subtle forms (e.g. *munda*, *kempi*), already synonymised by various recent authors (e.g. Jouanin & Mougín 1979), are not treated here because we agree with their decisions. Presumed breeding birds from the southeast Pacific (e.g. Chiloe Is., Juan Fernandez Is.) are invariably assigned to Little, possibly closely related to the Australian and/or New Zealand groups, but there is a paucity of information on these (Fleming & Serventy 1943, Jehl 1973, Harrison 1983).

The above polytypic species listed above all share several characters that vary within the group involved, perhaps because of common ancestry, primarily the colour of the undertail coverts, under remiges, and upperparts. Thus in *P. (l.) nicolae*, most populations have brown undertail coverts whereas *bailloni* has white, and vice versa in *P. assimilis* with regard to *boydi*. However, all the species proposed, monotypic or polytypic, have developed their own distinctive features of body/wing/tail proportions, bill structure, plumage colouration (upperparts and underwing coverts) and bare parts. For example, *P. bannermani* has a distinctive ash-grey collar and contrasting blackish-brown mantle. In this welter of forms, we consider that *P. atrodorsalis* clearly stands out as a distinct species due to its unique Manx-like plumage (including head pattern) and body/wing/tail proportions (but not overall size), and in having a combination of other characters (dark remiges, white undertail coverts, long and slender bill) that is not shared by, and on present evidence prevents it from being linked with, any other form.

Additional information

Another indeterminate shearwater described by Berruti (1990) was a specimen from Transvaal Museum, TM 74351, which had been collected on 15 September 1988 in the Kruger National Park, South Africa. It was sent on loan to the BM (NH) and we determined it to be a Little Shearwater of the race *boydi*, apparently the first of this subspecies to reach southern Africa (Sinclair *et al.* 1982). It is small in size (wing 181; tail 74; bill 25.3 (exposed culmen), 34.3 mm (to skull), 19.1 mm (anterior nostril to bill tip); tarsus 37 mm), and its plumage characters are as follows: slaty-blackish above, diffuse white area around the eye, bluish-grey bare parts as Little but having dark undertail coverts. Another apparent *boydi*, also recorded far south of its breeding range (Cape Verde Is.), was measured and released on St Helena in the South Atlantic in February 1975 (Bourne & Loveridge 1978). These *boydi* records, and the single record of *P. l. bailloni* from East London, South Africa (Courtenay-Latimer 1953), show that these small shearwaters are capable of long-distance vagrancy, caused presumably by an individual becoming lost or disorientated and then

becoming involved with movements of other migrant species of shearwaters (Harrison 1983).

Acknowledgements

The authors wish to acknowledge the assistance given to them by the staff of the BM (NH), Tring: Mark Adams, Dr Robert Prŷs-Jones, Michael Walters and Mrs F. E. Warr, also Dr A. G. Knox and Dr D. W. Snow for advice and encouragement. We are indebted to the staff of both the Durban and Transvaal Museums for promptly sending us a loan of the two specimens. We should also like to thank Richard Brooke, Miguel McMinn Grivé, Christian Jouanin, Jon King, Terry Oatley, Storrs Olson, Carl Vernon, Cyril Walker, and Graham Wragg for their opinions and help. Oliver Crimmen (BM (NH), London) was instrumental in producing x-rays of various skin and spirit specimens for which we are exceedingly grateful. Peter Hayman was exceedingly helpful in preparing scale drawings of the new species of shearwater, also scale drawings (from skin/spirit specimens) of Audubon's, Little and Persian Shearwaters which were invaluable in our discussions. HS particularly thanks Rehovot Tours, the International Birding Centre Eilat, the Society for the Protection of Nature in Israel, Amir Ben-Dov, Ehud Dovrat and Eli Shirihihi who have sponsored various aspects of this study, most especially the cost of travelling from Israel to the U.K. and other expenses. Finally HS acknowledges considerable help from John Morgan, starting with their joint observation of the Eilat bird, through subsequent discussion and publication, and finally for word-processing and editing the manuscript in its earlier stages.

References

- Berruti, A. 1990. On two indeterminate shearwaters from South African waters. *Bull. Brit. Orn. Cl.* 110: 66–70.
- Bourne, W. R. P. 1959. A new Little Shearwater from the Tubau Islands: *Puffinus assimilis myrtae* subsp. nov. *Emu* 59: 212–214.
- Bourne, W. R. P. & Loveridge, A. 1978. Small shearwaters from Ascension and St Helena, South Atlantic Ocean. *Ibis* 120: 65–66.
- Courtenay-Latimer, M. 1953. Sea bird migrants. *Ostrich* 24: 50–51.
- Cramp, S. & Simmons, K. E. L. (eds). 1977. *The Birds of the Western Palearctic*. Vol. 1. Oxford Univ. Press.
- Fleming, C. A. & Serventy, D. L. 1943. The races of *Puffinus assimilis* in Australia and New Zealand. *Emu* 43: 113–125.
- Harrison, P. 1983. *Seabirds: an identification guide*. Croom Helm.
- Hoyo, J. del, Elliott, A. & Sargatal, J. (eds). 1992. *Handbook of the Birds of the World*. Vol. 1. Lynx Edicions, Barcelona.
- Jehl, J. R., Jr. 1973. The distribution of marine birds in Chilean waters in winter. *Auk* 90: 114–135.
- Jouanin, C. 1970. Note taxonomique sur les petits puffins *Puffinus lherminieri* de l'Océan Indien occidental. *Oiseau* 40: 303–306.
- Jouanin, C. & Mougou, J.-L. 1979. Order Procellariiformes. In E. Mayr & G. W. Cottrell (eds), *Check-list of Birds of the World*. Vol. 1 (2nd edn.). Museum of Comparative Zoology, Harvard.
- LeCroy, M. & Vuilleumier, F. 1992. Guidelines for the description of new species in ornithology. *Bull. Brit. Orn. Cl.* 112a: 191–198.
- Louette, M. & Herremans, M. 1985. A new race of Audubon's Shearwater *Puffinus lherminieri* breeding at Moheli, Comoro Islands. *Bull. Brit. Orn. Cl.* 105: 42–49.
- Marchant, S. & Higgins, P. J. (eds) 1990. *Handbook of Australian, New Zealand and Antarctic Birds*. Vol. 1. (Pt. A.). Oxford Univ. Press.
- Murphy, R. C. 1927. On certain forms of *Puffinus assimilis* and its allies. *Am. Mus. Novit.* 276.
- Murphy, R. C. 1928. Birds collected during the Whitney South Sea Expedition IV. *Am. Mus. Novit.* 322.
- Palmer, R. S. 1962. *Handbook of North American Birds*. Vol. 1. Yale Univ. Press.
- Sibley, C. G. & Monroe, B. L., Jr. 1990. *Distribution and Taxonomy of Birds of the World*. Yale Univ. Press.

- Shirihai, H. & Sinclair, I. 1994. An unidentified shearwater at Eilat. *Birding World* 7: 274–278.
- Sinclair, J. C., Brooke, R. K. & Randall, R. M. 1982. Races and records of the Little Shearwater *Puffinus assimilis* in South African waters. *Cormorant* 10: 19–26.
- Vaurie, C. 1965. *The Birds of the Palearctic fauna (non-Passerines)*. Witherby, London.
- Svensson, L. 1992. *Identification Guide to European Passerines*. The Author, Stockholm.
- Wetmore, A. 1959. Description of a race of the shearwater *Puffinus lherminieri* from Panama. *Proc. Biol. Soc. Washington* 72: 19–22.

Addresses: Hadoram Shirihai, P.O. Box 4168, Eilat, Israel. Ian Sinclair, 20 Pleasant Place, Pinelands, Cape Town, 7405 South Africa. Peter R. Colston, Bird Group, Dept. of Zoology, The Natural History Museum, Tring, Hertfordshire HP23 6AP, U.K.

APPENDIX
Measurements (in mm) of *Puffinus assimilis* and *P. herminieri* subsp., and *P. atrodorsalis* sp.nov.

Sex	n	Wing	Tail	Bill exposed culmen	from skull	Tarsus	Source
<i>Puffinus assimilis baroli</i> (Azores, Madeira, Canary Islands)							
M	5	176-187 (181.0, 4.5)	66-72 (69.2, 2.38)	25-28.5 (26.4, 1.5)	31-33.5 (31.7, 1.1)	36-39 (37.2, 1.1)	1
F	5	168-182 (176.8, 5.26)	67-77 (71.8, 4.15)	24-26 (25.0, 0.84)	29-31 (29.8, 0.83)	35-38 (36.5, 1.14)	1
<i>Puffinus assimilis tunneyi</i> (SW Australia)							
M	6	176-182 (177.7, 2.16)	65-70 (67.3, 2.07)	22.6-25 (23.7, 0.79)	—	36.8-38.4 (37.5, 0.57)	2
F	8	171-179 (174.6, 2.78)	62-68 (65.5, 2.34)	21.9-24.6 (23.5, 0.84)	—	34.8-38.6 (36.7, 1.08)	2
O	6	163-181 (169.8, 7.65)	65-75 (67.3, 5.35)	23-25 (23.7, 0.75)	29-31 (30.5, 0.83)	34-38 (36.2, 1.48)	1
<i>Puffinus assimilis assimilis</i> (Lord Howe & Norfolk Is.)							
M	4	165-178 (172.8, 5.5)	65-71 (68.0, 2.6)	23.5-26 (24.9, 1.03)	30-32 (31.1, 0.85)	35-37.5 (36.1, 1.1)	1
F	5	171-188 (176.0, 7.3)	67-73 (69.0, 2.3)	22-25 (24.0, 1.27)	30-31 (30.6, 0.54)	35-39 (37.4, 1.55)	1
O	4	170-182 (176.75, 5.4)	64-68 (66.3, 1.7)	24-26.5 (25.0, 0.13)	29.5-33 (31.6, 1.5)	35-39 (36.5, 1.7)	1
<i>Puffinus assimilis kermadecensis</i> (Kermadec Is.)							
M	4	189-195 (192.8, 2.49)	68.5-72.5 (70.0, 1.66)	25-26.4 (25.6, 0.51)	—	39.1-41.6 (40.2, 1.04)	2
F	4	185-194.5 (190.3, 3.44)	69.5-71 (70.0, 0.61)	25.2-27.3 (26.0, 0.85)	—	39.6-42.1 (40.4, 1.25)	2
O	6	175-195 (186.5, 6.75)	62-68 (65.3, 2.94)	25-27 (25.8, 0.93)	29-32 (30.8, 1.32)	37-39 (38.2, 0.75)	1
<i>Puffinus assimilis haurakiensis</i> (NE New Zealand)							
O	16	181-200 (192.1, 5.81)	63-72 (69.3, 3.05)	23-29 (26.4, 1.45)	—	40-43 (40.9, 1.0)	2
F	1	191	74	26	31	40	1
<i>Puffinus assimilis elegans</i> (Breeds islands S. Atlantic & on Chatham Is. and Antipodes Is. etc.).							
O	7	184-198 (187.9, 5.46)	63-70 (66.0, 2.58)	25-26 (25.6, 0.5)	31-33.5 (32.5, 0.89)	39-41 (40.1, 0.9)	1
O	6	182-192 (188.0, 3.32)	(n=5) 61-71 (66.9, 3.54)	(n=7) 23.6-26 (24.5, 0.85)	—	(n=8) 39.2-42.2 (40.5, 1.12)	2
<i>Puffinus assimilis myrtae</i> (Rapa Is.)							
F	1	196	81	25	32	41	1

Continued